National Ocean Survey Abstracts-1980

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U. S. DEPARTMENT OF COMMERCE
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National Oceanic and Atmospheric Administration
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PREFACE

The National Ocean Survey (NOS) provides charts and related information for the safe navigation of marine and air commerce. NOS also furnishes other Earth science data from geodetic, hydrographic, oceanographic, geomagnetic, seismologic, gravimetric, and astronomic surveys, observations, investigations, and measurements.

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Agreen, R.

Storage of satellite altimeter data. NOAA Technical Memorandum, NOS-NGS 28, pp. 16, December 1980. (PB 81-164360)

Software has been developed for storing any amount of satellite altimeter data on tape and/or disk devices with the ability to select parts of existing data sets and form new ones as required. The same data set structure is employed for storage and applications, and the users are encouraged to run the maintenance software to tailor altimeter data sets to their specific needs. These features were designed to provide sufficient data manipulation capability for research without the extensive development effort needed for a true data base. The system is written in IBM FORTRAN. Instructions for the user are not provided because they are subject to change.

Appell, G. and Mero, T.

Design and initial testing of a three-axis current meter. Oceans 80, pp. 4, September 1980.

A prototype of an attended 3-axis acoustic current meter/CTD has been built and has undergone extensive laboratory testing. In addition to a conventional CTD sensor head, the instrument included transducers for measuring current velocity along three paths, three components of earth magnetic field and three components of acceleration. Reported here are results of testing the velocity sensors in a tow tank. A noteworthy feature of the instrument design is that the acoustic paths, along which the current velocity is measured, are arranged so that disturbance of the measured flow by supporting struts or by the sensors themselves is greatly reduced. Estimated errors in the velocity measurements are found to be characteristically on the order of a few tenths of a percent at a speed of 40 cm/sec.

Baer, L.

A new national program to provide wave information. Coastal Zone '80, The Second Symposium on Coastal and Ocean Management, November 1980.

The National Ocean Survey has begun a new program to provide basic statistics and measured and hindcast wave data for all ice-free U.S. coastal oceanic waters. The program will concentrate on providing the extreme value statistics and other wave charactristics needed for establishing and validating design criteria for marine structures and coastal works. It will also support wave forecasting. The program includes six types of activities: measurements, hindcasting, data management, quality assurance, statistics, and user coordination. The technical approach is to use present technology while developing improvements. The program co-sponsored the Atlantic Remote Sensing Land Ocean Experiment (ARSLOE) off Duck, North Carolina, in October and November 1980 to intercompare various wave measurement systems and test wave models. Eventually about 20 measurement systems will be deployed. A laboratory calibration system has been developed to test the performance of wave measuring buoy electronics. Hindcast type models will be developed and

used to interpolate between measurement systems to minimize the number of expensive measurement stations needed. The program has hosted a major workshop on hindcasting and forecasting of wave models and is planning workshops on user requirements and instrumentation.

Balazs, E.

Geodetic leveling techniques in use and under development for the U.S. releveling program. Second International Symposium on Problems Related to the Redefinition of North American Vertical Geodetic Networks, Ottawa, Canada, May 1980.

In contrast to almost 50 years (1916-64) of instrumental and procedural stability in the leveling program of the former U.S. Coast and Geodetic Survey (now the National Ocean Survey), many changes have occurred during the past 15 years. This paper describes new level instruments, level rods, observing procedures, and automated recording systems. These advances are an integral part of the of the National Ocean Survey/National Geodetic Survey's readjustment of the National Geodetic Vertical Datum.

Bossler, J.

Report on the XVII General Assembly of the International Union of Geodesy and Geophysics. ACSM Journal, February 1980.

The activities of the International Association of Geodesy (IAG), one of seven semi-autonomous associations within IUGG, are of special interest to the members of ACSM. Of the 2,000 attendees, approximately 300 scientists, representing 49 countries, were associated with the IAG. From this group, 40 participants came from the United States. The expertise of the U.S. delegates spanned such topics as control surveys, gravimetry, space techniques, crustal motion, and polar motion. The IAG is composed of five sections and several commissions covering the general topics of new methods for control positioning; national and regional networks; global gravity variations; fundamental constants and reference systems for the Earth, Moon, and planets; the theory of dynamics of the Earth-Moon system; and other mathematical methods in geodesy. The sections and commissions support special study groups and prepare technical summaries and reports of their activities. Resolutions and proceedings of the IUGG XVII General Assembly will be published in a forthcoming issue of the Bulletin Géodésique. Resolution 7, which is reprinted here, affects the surveying community in the United States because the constants adopted for the Geodetic Reference System 1980 will be used to reference the North American Datum 1983. (See Article No. 17 on the New Adjustment of the North American Datum, ACSM Bulletin, Vol. 67, November 1979, pp. 19-20.) This resolution was an important accomplishment of the meeting.

Balazs, E.

The 1978 Houston-Galveston and Texas Gulf Coast vertical control surveys. NOAA Technical Memorandum, NOS-NGS27, pp. 63, November 1980.

Comparisons between leveling surveys of different epochs are used to determine vertical displacement of permanent bench marks. Displacement of bench marks usually represents the movement of the surrounding area. In this report, the 1978 Houston-Galveston and Texas Gulf Coast releveling surveys are compared to the 1963, 1973, and 1976 releveling results. The changes in elevations of bench marks common to two or more epochs are tabulated and plotted in Appendix A. From these differences, contour maps were prepared for the 1963-78 and 1973-78 epochs in the 2 x 2 degree area of maximum subsidence. Annual subsidence rates computed for the 1973-78 period are about 25 percent less in the maximum subsidence area than the rates computed for the 1963-1973 period.

Berstis, K.

ARGO DM-54 and Raydist DRS Positioning System Stability. Fifth International Offshore Conference, March 1980, Ocean Management Journal, March 1980.

In 1978 NOAA procured the Cubic Western Data ARGO DM-54 system for use by the National Ocean Survey (NOS) for position location during hydrographic surveys and oceanographic investigations. The ARGO (Automatic Ranging Grid Overlay) positioning system is a pulsed phase comparison system operating in the medium frequency (MF) band (1.6-2 Mhz) using the ground wave component of the radiated signal. User results on the performance of medium range positioning systems vary widely.[2] In NOS survey operations calibration errors or offsets have occurred when returning to fixed calibration points using medium range positioning systems. To resolve the questions of calibration errors and system accuracy a program was initiated to measure the expected performance under operational conditions and to develop a standard field test procedure that could be used as an NOS input to the FIG Working Group 414B on positioning systems. In the initial phase of the program, stability tests under static conditions were conducted on the ARGO system in September 1978 and April 1979. These tests were conducted using the ARGO whip antenna at ranges of 18-440 km. in a "test" range on the concave coast between New Jersey and North Carolina. As a result of these tests, Cubic has developed phase stabilization lane jumps. This option was implemented and tested on the NOS ARGO system in January 1980.

Bossler, J., Goad, C., and Bender, P.

Using the global positioning system for geodetic positioning. Bulletin Géodésique, November 1980.

The development of relatively inexpensive satellite receivers in the early 1970's has resulted in cost-effective applications of satellites for a variety of geodetic surveying needs. Currently achievable accuracies range from 10 to 20 centimeters. The NAVSTAR Global Positioning System, now under development by the Department of Defense, incorporates advanced technology which has the potential capability of revolutionizing satellite geodesy. Several concepts for utilizing GPS signals are briefly reviewed, and another concept, called the reconstructed carrier phase method, is described in some detail. This concept is being pursued by the Defense Mapping Agency, National Oceanic and Atmospheric Administration, and the U.S. Geological Survey. These agencies

have numerous requirements for accurate positioning. Several prototype receivers are planned to be available for testing in mid-1982. These receivers should be highly portable, consume little power, and obtain accuracies of several centimeters in several hours of observation time. However, water vapor radiometers will be needed in order to achieve the full accuracy. Initial simulation results utilizing the reconstructed carrier phase method are included.

Bossler, J. and Hanson, R.

Application of special variance estimators to geodesy. NOAA Technical Report NOS84 NGS, pp. 16, February 1980. (PB223332)

Special variance estimators are computed and analyzed for a standard geodetic network adjustment. One important estimator requires the computation of non-integer degrees of freedom. Results obtained from constraining the coordinates of peripheral network stations by a priori variances are analyzed. Several extensions of these results are suggested.

Carter, W.

Frequency modulation of the Chandlerian component of polar motion. Journal of Geophysical Research, 1980.

Detections of variations in the frequency of the Chandlerian component of polar motion have been reported by several investigators, starting at least as early as S. C. Chandler's report of 1892. The concept has never gained general acceptance because no credible cause has been identified. Investigations reported in this paper suggest that the Chandlerian component may be frequency modulated as a linear function of the polar motion magnitude. The variation in frequency is estimated to be a $\sim$0.03 to 0.06 cycles per year increase per 0.1 second of arc decrease in the polar motion magnitude. Nonequilibrium response of the oceans to polar motion, which takes the form of a pole tide that varies in enhancement and phase lag, is suggested as a possible cause of the frequency modulation.

Chin, M.

Adjustment of LaCoste and Romberg gravimeter observations. American Geophysical Union Spring 1980 meeting, Toronto, Canada, May 1980.

In this newly developed adjustment system the observation equation uses the dial reading, in milligals, as the observable quantity. Neither the gravity observation difference between the two stations nor the gravity observation itself is used. Scale factors, drift rates, intervals (tare corrections), and gravity values are the unknown parameters. Because this is a nonlinear model, the Newton-Gauss iteration procedure is used. Gross data errors are examined in the first iteration. By using the software package developed by the National Ocean Survey for processing large sparse normal equations, the size of the network that the system can handle is constrained only by hardware limitations. Very large networks can be processed in relatively small computer storage by partitioning the equations.

Chovitz, B.

Modern geodetic earth reference models. EOS: Transactions of the American Geophysical Union, September 1980.

A geodetic earth reference model is defined by a self-gravitating body of given mass and rotational rate, whose surface is an equipotential ellipsoid of revolution of specified dimensions. Over the course of this century, the International Association of Geodesy has sanctioned three such models as recommended standards for both scientific and pratical applications. The most recent model was approved in December 1979 replacing one chosen in 1967, which in turn supplanted another originally adopted four decades earlier.

Chovitz, B. and Grafarend, E.

Bruns transformation and a dual set up of geodetic observational equations. NOAA Technical Report, NOS85 NGS16, April 1980. (PB80-202302)

The Bruns formula, which equates the disturbing gravity potential modulo the length of the normal gravity vector to the height anomaly, is generalized into three dimensions and into horizontal, equatorial, and inertial reference frames. It is applied to formulate the space-like geodetic boundary value problem in geometry and gravity space. The Bruns transform allows a dual setup of geodetic observational equations in a network of mass points, the finite element approximation of the space-like geodetic boundary value problem, in the following sense: The observational equations can be expressed rigorously either as a function of geometric coordinate corrections alone without any gravity dependent quantity, or alone as a function of the gravity disturbing potential and its gradients alone without any geometric coordinate correction. For operational purposes, estimable quantities from reference-free observables are studied in geometry, gravity, and vorticity spaces. They correspond to invariants with respect to a linear similarity transformation typified by positional angles and length ratios in various vector spaces. A Cartesian series representation of the gravity potential and its gradients is given--the Cartesian coordinate system is known to be singularity-free--and is used for a unified Cartesian setup of observational equations.

Cohen, P.

Observations on a seamap. International Hydrographic Review, April 1980.

An analysis of a small-scale bathymetric map, SEAMAP #13242-12B, at 1:1,000,000, published by the U.S. National Ocean Survey, is presented, together with information on its genesis and format and comments on the potential of maps depecting ocean bathymetry.

Collum, J. and Spencer, J.

The development and present status of National Geodetic Control diagrams. American Congress on Surveying and Mapping Conference, St. Louis, Missouri, March 1980.

This paper convers the developmental stages of the U.S. National Geodetic Networks and their subsequent cartographic representation as geodetic control diagrams. The first geodetic control diagram was a project sketch of the field work performed in New York during 1816 to 1817. From this early beginning, until the completion of the North American Datum (NAD) of 1927 and the National Geodetic Vertical Datum (NGVD) of 1929, control diagrams were shown either as project sketches or network composites in the final survey reports. In the 1930's, geodetic control diagrams were mass produced to allow the user to select specific stations pertaining to NAD27 and NGVD29 and to plan for future surveys. With the anticipated completion of NAD83 and NGVD85, and the increased trend of surveying activities, a greater need for geodetic control diagrams is expected. To deal effectively with this need, the National Ocean Survey/NOAA is procuring a computer-assisted cartographic system. Activities pertaining to these developments are traced from the Coast Survey's first geodetic survey to the National Ocean Survey's anticipated redefinition of the North American Datum and the National Geodetic Vertical Datum in the mid 1980's.

Diamante, J., Douglas, B., Porter, D., and Masterson, R.

The surface truth for the Seasat-calibration experiment. Journal of Geophysical Research, October 1980.

A calibration experiment for the Seasat radar altimeter was conducted in the Bermuda Calibration Area during September and October 1978 by a group of federal government agencies, universities, and research organization. As part of the Seasat calibration activities, a tide gage was installed by the National Ocean Survey at an open coastal location on Bermuda to provide a determination of the instantaneous sea-surface height during the Seasat overflights of the island. The tide gage was geodetically tied to the laser tracking station on Bermuda, so that Seasat's position relative to the sea surface could be determined independently and compared with the value provided by the altimeter measurements. The RSS error in the determination of the vertical position of the laser, relative to the sea surface, has been estimated to be 4.0 cm, exclusive of errors due to the present lack of precise information on the elevations of the geoid at Bermuda. When errors due to the present lack of information on elevations of the geoid are taken into account, the maximum RSS error increases to 5.0 cm.

Diamante, J. and Nee, T.

Application of radar altimeter data to the determination of regional tidal constituents and the mean sea surface. Symposium on Oceanography from Space, Venice, Italy, May 1980.

A method has been developed to extract the systematic satellite ephemeris error signatures at long wavelengths from satellite radar altimeter data. The ephemeris error signatures along the orbital arcs are determined by extrapolation beyond a reference region where an accurate gravimetric geoid and empirical tide model based on conventional tide gage data are available. The mean sea surface and the tidal constituents are then derived from the corrected satellite altimeter data in the extended extrapolation areas. The method has

been applied using Geos-3 altimeter data in the Geos-3 Atlantic Ocean Calibration Area, using a portion of the Hatteras Abyssal Plain as the reference area. The Marsh-Chang 5' x 5' geoid in that area and the empirical ocean tide model of H. O. Mofjeld provided the reference geoid and tide models, respectively The mean sea surface and five tidal constituents have been derived in the extrapolation region.

Diamante, J. and Nee, T.

Determination of the principal tidal constituents and the mean sea surface in the western mid-Atlantic Ocean calibration area using radar altimeter data from GEOS-3 and Seasat. EOS: Transactions of the American Geophysical Union, Vol. 61, No. 14, November 1980.

Six tidal constituents (M_2, N_2, S_2, K_1, O_1 and P_1) and the mean sea surface were determined within the Geos-3/Seasat Atlantic Ocean calibration area off the southeast coast of the United States. Six hundred and seventy-nine passes of the final release Geos-3 radar altimeter data were used in this solution. Using 43 passes of radar altimeter data from Seasat, a solution for the three lunar tidal constituents (M_2, N_2, and O_1) and the mean sea surface were obtained for approximately the same area. The Seasat data set exhibited problems of low density, short duration of the time series and generally poor distribution in space and time. However, in spite of these problems, reasonably good agreement was shown between the three lunar tidal constituents in the Seasat solution and the corresponding constituents in the Geos-3 solution. The relatively short Seasat time series caused particular difficulties in the solutions for the solar tidal constituents (S_2 and P_1) and the lunar-solar constituent K_2). Consequently, the solution did not converge when the method was applied to the Seasat data set for the six tidal constituents. A solution combining the available data from both Geos-3 and Seasat was also obtained. Comparison of the six tidal constituents based on the altimeter data with the available deep sea tide gage measurements in the area shows generally good agreement.

Dillinger, W.

Subroutine package for processing large, sparse least squares problems. NOAA Technical Memorandum NOS-NGS29, October 1980.

A package of subroutines has been compiled to make it relatively easy for applications programers to use several existing subroutines for forming and solving very large, sparse sets of normal equations. The package provides a relatively easy method for reordering, solving, and computing a partial inverse for sparse matrices, including the step of building the normal equations from the observation equations. There are two sections to the package: One reorders the normal equations; the other builds the normal equations and then reduces, solves, and computes the inverse. The two sections can be used independently, although they were designed to be used together. The implementation of each section involves three basic steps: (1) initialize some work space, (2) pass the observation equations to the system, and (3) call for the needed operation. The number of parameters passed in each call has been kept to a minimum to make the procedure easy to understand and use. A simple example is shown for the quick implementation of this package.

Douglas, B.

Determination of geoid and ocean surface variability using GEOS-3 altimeter data. American Geophysical Union 1980 Fall Meeting, San Francisco, California, December 1980.

In the spring of 1980 NASA/Wallops Flight Center released a revised and expanded set of Geos-3 altimeter data to NOAA for archiving and distribution. These data appear to have a precision of about $\pm$ 30 cm at the rate of one per second. We have used collinear (repeated) passes of these data in the western North Atlantic Ocean to measure mesoscale variability and to evaluate the 5' x 5' gravimetric geoid computed by NASA's J. G. Marsh. The error in the gravimetric geoid is correlated with the bathymetry, reaching several meters near the Puerto Rican Trench. The variability of the sea surface obtained by intercomparing collinear passes agrees well with the results obtained from hydrographic surveys. The greatest limitations of the Geos-3 data are due to the nonsystematic schedule of data acquisition and the lack of very close (<1-2 km) groups of collinear passes.

Douglas, B.

On the use of satellite altimeter data for radial ephemeris improvement. Journal of Astronautical Science, October 1980.

Several satellites have carried radar altimeters to measure precisely the distance from the satellite to the ocean surface. Since the ocean surface is nearly level, these data have been used extensively to determine the marine geoid and gravity anomalies. In this paper we consider an inverse problem of correcting the radial (i. e., altitude) ephemeris of a satellite using altimeter data and a geoid model. Such models are very accurate for the longer wavelengths close to the dominant wavelengths (> 120°) of satellite ephemeris error. Using a least-squares procedure that minimizes the discrepancy between the GEM-10B geoid and Seasat altimeter sea-surface profiles at long wavelengths in addition to minimizing the discrepancy of repeated measurements of sea-surface height at intersections of the Seasat ground track, we have obtained a corrected Seasat radial ephemeris that yields agreement of apparent sea-surface height at intersections of the ground track to 0.5 m. Uncertainties in the tides and atmospheric loading are adequate to account for the remaining discrepancies.

Douglas, B.

SEASAT altimeter observations of seasurface topography. SEASAT workshop of the Marine Technology Society, Washington, D.C., October 1980.

In addition to measurement of sea state and wind speed, the SEASAT radar altimeter was capable of measuring the distance from the satellite to the ocean surface to a precision of 10 cm or better (1), (2). A global data set with near 1-degree coverage was obtained, as were repeated (collinear) tracks that enabled observation of the variations of the sea surface topography (i.e., shape) over a global, but sparse, grid. Converting these data to meaningful quantities in a geophysical sense involves several aspects of geodesy and oceanography.

Embley, R.

Acoustic stratigraphy and biostratigraphy of neogene carbonate horizons in the North equatorial Pacific. Journal of Geophysical Research, Fall 1980.

Distinctive acoustic reflectors have been identified and traced over hundreds of kilometers on both low-frequency (air gun) and high-frequency (3.5 kHz) seismic profiles from the region immediately to the north of the Clipperton Fracture Zone in the equatorial Pacific. The reflectors result from impedance contrasts between carbonate-rich layers (up to 90 percent $CaCO_3$) and siliceous clays, and they represent sharp decreases in porosity, increases in wet-bulk density, and decreases in sound velocity. The reflectors have northern limits which increase with increasing age: reflector R_0 (late Pleistocene) occurs only south of $\sim$5°N; R_1 (upper Miocene) occurs south of $\sim$6°N; and R_2 (middle to lower Miocene) extends to at least 10°N. Radiolarian biostratigraphy of the piston cores shows that the most extensive of the reflectors, R_2, is clearly time-transgressive within the middle and lower Miocene. The variable geographic extent and the time-transgressive nature of individual acoustic reflectors are in part a consequence of the northward component of motion of the Pacific Plate during the Neogene, with carbonate sedimentation generally restricted to a narrow equatorial region south of $\sim$5°N. There are no detectable unconformities within core intervals corresponding to the three major reflectors; hence the reflectors apparently do not represent significant erosional episodes.

Embley, R.

The role of mass transport in the distribution and character of deep ocean sediments with special reference to the North Atlantic. Marine Geology, December 1980.

The distribution and character of mass flows, particularly on the North American margin, are described. On seismic records mass flow characteristics range from contorted internal reflectors and a hummocky surface to acoustically transparent, lens-shaped deposits. The acoustic character also partly depends on the degree of lithification of the sediment; lithified or semilithified material will form more irregular deposits than will unconsolidated muds even though translated over the same slopes and distances. Mass flow structures found in cores are difficult to interpret, usually because of the small diameter of the sampler. In fact, mass flow deposits cored with a standard piston corer are sometimes not even recognized. The primary sedimentary structures found in mass flow deposits range from angular contacts to convoluted folds to clasts of lithified or semilithified sediment or sand inclusions. These structures are related to the amount of translation, the lithology of the parent material and the slope over which the flow moved.

Embley, R. and Morley, J.

Quaternary sedimentation and paleoenvironmental studies of Namibia (Southwest Africa). Marine Geology, August 1980.

An examination of sediment from piston cores and 3.5-kHz seismic reflection profiles from the northern Cape Basin and southern Angola Basin reveal a contrasting history of depositional processes in these adjacent basins. Pleistocene sedimentation in the southern Angola Basin was characterized by extensive deposition of turbidites and hemipelagic sediments derived primarily from the discharge of the Kunene River. Slumping of sediments and highly mobile flows have also contributed in the basinward transport of sediments in this region. In contrast, the northern Cape Basin can be characterized as a "starved" basin. Because of the low coastal rainfall and extremely low level of river discharged, the marine sediments along this margin are essentially pelagic in origin. Slumps and slides have disrupted portions of the continental margin but the morphology of the slope is very smooth in contrast to the margin north of the Walvis Ridge where canyon cutting has played a major role. The low sedimentation rates in the northern Cape Basin in conjunction with a moderate to strong bottom-water circulation has resulted in an extensive erosional zone along the lower continental rise off southwest Africa. The effects of a changing climate (interglacial-glacial) on marine productivity and sedimentation are documented by the faunal and isotopic record in a piston core on the continental rise south of the Walvis Ridge.

Enabnit, D.

An evaluation of airborne laser hydrography. Australian defense laser hydrography symposium, Adelaide, Australia, October 1980.

The National Ocean Survey (NOS) has been investigating airborne laser hydrography since 1970. The objective of that work was to determine if the technique could perform accurate hydrographic surveys at a significantly reduced cost and with significantly reduced manpower. The airborne laser hydrographic technique uses an aircraft-mounted, pulsed laser system to collect a swath of discrete soundings along each flight line. It measures water depth exactly like a sonar, using light instead of sound. The NOS operational system will take 600 soundings per second over a 200-meter wide swath with an average distribution of 1 per 25 m^2. The system will operate from a light, twin-engine aircraft flying at 300 meters and 75 m/sec. The laser will have a green wavelength for maximum water penetration and will be totally eye safe for bystanders in the survey area. As part of the NOS investigation, the major benefits of airborne laser hydrography were identified and quantified. The cost of laser surveying was modeled and compared to historical costs for launch-based sonar surveying. It was concluded that laser hydrography could be performed on one-sixth the cost of launch hydrography on a per-unit-area basis. A similar analysis showed that laser hydrography required only one-fifth the manpower of launch hydrography per unit of area surveyed. Other major benefits were the ability of a single laser system to survey more area annually than the entire NOS launch fleet, and a 100-fold increase in the number of soundings per unit area.

Enabnit, D.

The hydrographic software/data processing subsystem of the NOS airborne laser hydrography system. Australian defense laser hydrography symposium, Adelaide, Australia, October 1980.

The concept of the NOS airborne laser hydrography system is one which is heavily dependent on a Hydrographic Software/Data Processing Subsystem. An all-digital approach to determining depth is desired. The ability to compute depths accurately will determine the acceptability of laser data. The effectiveness of the data management software will determine the ability to maintain quality control and to use the data.

Enabnit, D.

NOS' airborne laser hydrography development project. Australian defense laser hydrography symposium, Adelaide, Australia, October 1980.

The U.S. National Ocean Survey's (NOS) airborne laser hydrography development project has 4 phases: the research and evaluation phase, the development phase, the transition phase, and the operational phase. The research and evaluation phase established the technical performance and economic benefits of laser hydrography. That phase is essentially complete. The objective of the development phase is to develop, fabricate, and test an airborne laser hydrography system which will then be used operationally by NOS. This phase is expected to cost $2.3 million (1979 U.S. dollars), last 5 years, and require 3 man-years per year on inhouse effort. The system must measure water depth to within $\pm$ 0.3m (1 sigma) in water 0-20 meters deep and to within $\pm$ 1m (1 sigma) in water 20-100 meters deep. The geographic coordinates of each sounding must be determined within $\pm$ 4.6m (1 sigma). The system will probably be developed as 4 subsystems by separate contractors and then integrated by NOS. The 4 subsystems are: the airborne laser subsystem, the position and attitude measuring subsystem, the hydrographic software/data processing subsystem, and the aircraft. The objective of the transition phase is to transfer the system from the developer to the user. This phase is expected to cost $400 thousand (1979 U.S. dollars), last one year, and require 8 man-years of inhouse effort. The following items are to be accomplished during the transition: training in system operation and maintenance, developmental and operational testing, accuracy certification, techniques development, and a final set of system modifications based on test results. The objective of the operational phase is to gather large quantities of accurate, inexpensive, bathymetric soundings. The operational phase will last 8 years, will cost $450 thousand (1979 U.S. dollars), and will require 5 man-years per year of inhouse effort. The system will be flown 600 hours per year, of which 300 hours will be actual surveying. The nominal mission parameters are: an altitude of 300m, a speed of 75m/sec, a duration of 4 hours, and an air crew of 2 with the system operating unattended. The principal areas to be surveyed are in the Gulf of Mexico, the U.S. east coast, and the Great Lakes. Typical survey areas are expected to be 75 km by 15 km and will be surveyed with overlapping swaths yielding a survey scale of 1:1,000. Approximately 7000 km^2 should be surveyed annually.

Flagg, J.

NOS strategic petroleum reserve support project. Sea Technology Magazine, June 1980.

The federal Strategic Petroleum Reserve, authorized by the Energy Policy and Conservation Act of 1975, was created in response to the 1973-1974 oil embargo's drastic disruptions to the U.S. economy. The Department of Energy (DOE), responsible for developing and implementing the SPR program, plans to store up to one billion barrels of crude oil under Louisiana and Texas in caverns produced by solution-mining subterranean salt deposits. A combination of characteristics make crystalline (rock) salt caverns highly attractive for petroleum storage. If the crystalline salt is relatively pure--not imbedded with significant quantities of other types of rock--it is generally impervious to liquid and gas, has a compression strength comparable to concrete under the weight of overlying and surrounding rock, moves like plastic to seal incipient fractures, and can be relatively easily mined by dissolving with water. The dissolved rock salt forms a saline solution of approximately 265 parts salt per thousand parts water, and has a temperature range of 27-37 degrees C. According to DOE salt dome petroleum storage is feasible wherever an adequate water supply and conditions for brine disposal coexist.

Fritz, L.

Laser measurement for photogeodesy. American Congress on Surveying and Mapping Spring Convention, St. Louis, Missouri, March 1980.

A development effort at the National Ocean Survey (NOS) has produced the world's most accurate large format comparator. The effort has combined the engineering precision of a Mann Automatic Stellar Comparator (MASC) with the inherent measurement accuracy of Hewlett-Packard dual-frequency laser interferometers. The completed comparator system uses the laser for measurement and precision lead-screws for stage transport. Experiences obtained from this integration are discussed. Submicrometer measurement accuracies over the 10 x 20 inch comparator format provide the capability for the high-precision photogrammetry and photogeodesy now being performed at the NOS. Typical photogeodesy results indicate horizontal ground position accuracies of better than 4.5 cm., from 1:24,000 scale photography, for all ground targets spaced at one-mile intervals over a 400-square mile area. A streamlined data reduction flow has been developed for photogeodesy projects. It accelerates production throughout while minimizing opportunities for human errors. As a result, normal eight-hour measurement shifts have produced an average of over 3,150 measurements daily over a 3-month period for a 440 photo block project. The results and measurement techniques used for this project and a project requiring the calibration of a 529 reseau are discussed.

Fritz, L.

Testing procedures for analytical plotters. XIV Congress of the International Society for Photogrammetry, Hamburg, Federal Republic of Germany, July 1980.

Performance and acceptance tests of equipment are procedures for quality control that are essential in any evaluation process. The wide variety of analytical plotters on the market today, and their basic differences from analog plotters, requires that we institute a new look at these procedures. This paper addresses many of the test procedures that should be applied and

the underlying philosophy of these performance tests for analytical plotters. Included is what should be tested, why it should be tested, and how it can be tested. The approaches suggested are pragmatic in that they are addressed to the needs of the majority of analytical plotter users and are therefore designed to quantify performance. Practical simplified tests are proposed that will enable a typical user to verify that a particular analytical plotter is suitable for his needs or, to provide means for him to ascertain that his specifications for an analytical plotter have been met. An example from an actual analytical plotter acceptance test is presented.

Fury, R.

Automated recognition of similarities between objects via correlation analysis. Eighth World Computer Congress, Tokyo, Japan, October 1980.

A frequent need in automated transactions is to recognize similarities between coded objects. Occasionally, it is not sufficient to determine whether or not two objects (descriptive names) are identical; thus, some measure of similarity must be established. Difficulties in automated identification are caused by abbreviations and various qualifiers attached to the definitions. The development of a rigorous system for the distinction of similar objects would be cost prohibitive, experience shows that correlation analysis techniques that are built into an interactive system improve processing efficiency and reduce costs.

Fury, R.

Data bank techniques. International Association of Geodesy, Denmark, August 1980.

The National Geodetic Survey (NGS) has established and maintains numerous data banks for the storage of large volumes of geodetic and geophysical data. The organizations of these data banks have been optimized for single-key retrieval. Physically separated data sets are linked via-directories; economy in storage is achieved through data compression. Some data management methods chosen by NGS are computer system dependent, although equivalent methods are available on other systems. Others are completely independent from the system used. Access methods at various levels of sophistication will be explored, and the relationship of data banks to the geodetic data base will be discussed.

Fury, R.

Isolation of difference between similar text with an iterative algorithm. Eighth World Computer Congress, Tokyo, Japan, October 1980.

In recent years several techniques have been developed for isolating differences between similar texts. Some of the difficulties encountered in using these methods are complex and closed algorithms, are difficult to apply, the algorithm must be tuned to a given problem, it is difficult to detect false differences, the nonlinear relationship between the growth of the text, and the computation itself. Because the problem has no unique solution, none of the closed

algorithms is adequate for isolating the differences. Based upon this realization, a simple iterative algorithm has been developed that applies the "minimum distance of centroids" condition in the solution. The technique has proven to be very successful in isolating differences of considerable complexities between two similar texts.

Gaborski, P.

Comparison of GEOS-3 and SEASAT altimeter overland tracking. American Geophysical Union 1980 Spring Meeting, Toronto, Canada, May 1980.

GEOS-3 and Seasat overland altimeter measurements have been compared over areas of similar terrain in the San Joaquin Valley, Calif., and in the Houston-Galveston area of Texas. We observed that the Seasat altimeter height waveform processor, successfully customized for open-ocean tracking, introduces overland ranging errors as large as 5 m, as a result of specularity and changes in surface slope. The effects of specular returns on the Seasat measurements have been further evaluated over the Salar de Uyuni of southern Bolivia, the Earth's largest flat salt-covered area. The effects of surface slope changes have been examined over the Phoenix-Tucson area of Arizona. Initial attempts at retracking the Seasat overland waveforms have been successful, demonstrating the potential for achieving 10-cm overland tracking precision, compared with the observed GEOS-3 altimeter precision of about 40 cm over land.

Gergen, J.

Classical horizontal positioning. EOS: Transactions of the American Geophysical Union, Toronto, Canada, May 1980.

The North American Continent is covered by horizontal geodetic networks from the Northwest Territories of Canada to the southern latitudes of the Central American Republics. Throughout the past 150 years, several hundred thousand points have been surveyed with various instruments and at various precisions. The objective of the new adjustment of the North American Datum project is to eliminate all distortions which presently exist in the network by recomputing all geodetic positions. New instruments and techniques have allowed significant progress to be made during the last decade. Doppler satellite measurements finally give positions directly without the need for auxiliary measurements. Although modern positioning techniques are radically different from classical ones, precision surveys are still required to monitor crustal motion for engineering surveys.

Gergen, J.

The geodetic basis for precise photogrammetric densification. American Congress on Surveying and Mapping, Washington, D.C., February 1980.

Densification of horizontal control to support large-scale mapping of Ada County, Idaho, was performed by precise photogrammetric techniques. The precision of control points used for photogrammetic interpolation is important to assure

highest possible accuracy of adjusted points. Horizontal network analysis provides specifications for future surveys, geodetic field operations, as well as office computations. Actual cost figures are quoted. The accuracy of horizontal control stations has shown to be well within expectations for this precise photogrammetric densification survey. A postmortem horizontal verification survey is scheduled for January 1981. Results of this survey will be important for the overall assessment of the quality of such a cooperative effort between geodesy and photogrammetry.

Gergen, J.

Optimization of design and control networks. EOS: Transactions of the American Geophysical Union, August 1980.

This publication contains the proceedings of the International Symposium on Optimization of Design and Computation of Control Networks, held in Sopron, Hungary, July 1977, under the auspices of the International Association of Geodesy and the Geophysical Research Institute of the Hungarian Academy of Sciences. The 733-page, hard-cover volume is an attractive publication. Many interesting papers were presented at the symposium. These are all included in the text. In essence, the proceedings represent "a snapshot" of geodesy at the moment in 1977. As such, it is an historical document which will be read and studied by specialists for years to come. A symposium of this type offers geodesists worldwide an opportunity to gather and exchange their latest ideas and accomplishments at least once every 3 or 4 years. Hence, all papers cannot be considered as valuable contributions to the field. This publication contains a variety of papers both in terms of subject matter and quality. The sections are divided into eight segments which represent the eight symposium sessions.

Gill, S. and Porter, D.

Theoretical offshore tide range derived from a simple Defant tidal model compared with observed offshore tides. International Hydrographic Review, Monaco, January 1980.

A simple Defant model, based on the M_2 constituent, is presently used by the National Ocean Survey to estimate the offshore range of the tide, with observations at coastal tide stations of the actual tide supplying the necessary boundary condition for the model. The calculated values provide preliminary tide correctors for soundings obtained in offshore hydrographic surveys. Using offshore tide data from Deep Sea Tide Gage (DSTG) deployments and Offshore Telemetering Tide System (OTTS) buoys, the quantitative effects of the continental slope and shelf on the incoming semidiurnal tide are discussed, and anomalies in the predicted tide curve due to Hurricane Belle are shown. Comparison of the observed tide range with the theoretical tide range reveals the need to modify the initial Defant model, which is accomplished by decomposing the range into its major harmonic constituents, resulting in an improved calculated offshore range.

Goad, C.

The computation of tidal loading effects with integrated Green's functions. Second International Symposium on Problems Related to the Redefinition of North American Vertical Geodetic Networks, Ottawa, Canada, May 1980.

The usual method of predicting the effects of ocean tides on geodetic measurements is to use impulse response functions (called Green's functions) by convolving them with the desired ocean tide model. Because ocean tide representations are usually expressed as areas or cells of constant amplitude and phase, it has been found that the integrals of Green's functions are more desirable (because one singularity is removed) for use with tidal loading calculations. Their use allows for the inclusion of the height of the instrument above sea level. This method also directly uses sequences of load deformation coefficients, which is advantageous for making comparisons. This paper presents calculations of the loading effects on Earth-tide gravimeter measurements using a global M_2 ocean tide model developed by E. W. Schwiderski of the Naval Surface Weapons Center, Dahlgren, Va. The results look promising. For example, the tidal perturbations caused by the ocean appear to be predicted globally to the 0.5-microgal level.

Goad, C.

Positioning with global positioning system. International Astronomical Union Colloquium on Reference Systems for Earth Dynamics, Warsaw, Poland, September 1980.

The Department of Defense is scheduled to have six global positioning system (GPS) satellites in operation this year. The GPS satellites provide the potential for timing and 3-D position recovery for North America during certain segments of a day. By the mid-eighties, continuous timing and 3-D recovery from 18 GPS satellites are planned. Although the GPS is designed for fast position recovery to the 10-meter level, extended data collection periods could routinely yield subdecimeter relative positioning. The results of such data collection schemes, using the pseudorandom code and phase measurements of the reconstructed carrier, will be presented.

Grzeda, S.

Photographically assisted perspective stereo block diagram construction. The American Congress on Surveying and Mapping, Spring 1980 Convention, March 1980.

A photographic technique is presented and developed to assist the cartographer in the compilation of perspective stereo block diagrams. The 35mm single lens reflex (SLR) camera is utilized in a simple set up to facilitate generating the required photography for subsequent diagram compilation. The technique assists in the production of non-stereo perspective block diagrams as well.

Grzeda, S. and Hoover, R.

The National Ocean Survey's aeronautical obstruction data: photogrammetric verification program. The Ninth United Nations Regional Cartographic Conference for Asia and the Pacific, Wellington, New Zealand, February 1980.

The Office of Aeronautical Charting and Cartography (AC&C), National Ocean Survey (NOS), recently implemented a program for photogrammetric verification of obstructions (or hazards) to air navigation. The program became operational on June 6, 1979, after approximately 12 months of research and development. Over 200 obstructions were verified photogrammetrically in the first four months. This paper traces the development of the Photogrammetric Obstacle Verification Program.

Guenther, G.

Accuracy and penetration measurements from hydrographic trials of the A.O.L. system. Laser Hydrography Symposium, Adelaide, Australia, October 1980.

A series of controlled experiments were flown over two test areas in the Atlantic Ocean and Chesapeake Bay to investigate the effects of environmental parameters and system variables on AOL performance in the hydrographic mode. Results for penetration and depth measurement accuracy were reported and compared with existing models. Depth measurement biases are reported and discussed. The effects of off-nadir angle and receiver field-of-view are also reported.

Guenther, G.

The effect of multiple scattering in water on airborne lidar bathymeter accuracy. Laser Hydrographer Symposium, Adelaide, Australia, October 1980.

The concept of measuring water depth (bathymetry) with a pulsed lidar system involves determination of the time-of-flight difference between energy reflected from the air/sea interface and energy reflected from the "bottom". The spatial and temporal spreading of a light pulse through a multiple-scattering medium such as "natural" water can induce large biases in such depth measurements. These biases must be corrected in order for a system to meet the accuracy standards set for nautical charting. This paper presents the results of a quantitative estimate of the depth measurement biases obtained by Monte Carlo simulation of the radiative transport.

Guenther, G.

Error analysis of pulse location estimates for simulated bathymetric lidar returns. Laser Hydrographic Symposium, Adelaide, Australia, October 1980.

The two basic physical constraints on an airborne lidar hydrographic system are "accuracy" and penetration." The accuracy of depth measurements encompasses several concepts such as precision, repeatability, and comparability with

independent standards. Penetration involves the capability to detect and locate a return signal which has been reflected from the bottom and twice traversed the water column. Practical or useful penetration is limited not by detection, but by the ability to properly locate the bottom return pulse in time, i.e., by the required accuracy. Accuracy is thus the paramount concept upon which the design of such a system must be predicated.

Hess, R.

Tidal datum transfer study. Proceedings of the National Ocean Survey Hydrographic Survey Conference Seventh Annual Meeting, Gaithersburg, Maryland, January 1980.

Data collection procedures and results of a study to review methods for transferring tidal datums from a location with known datums to a location with unknown datums are discussed.

Hicks, S.

The National Tidal Datum Convention of 1980. NOS Technical Service Publication, May 1980.

For the first time in history, the United States has been provided with one consistent tidal datum system. Four actions, known collectively as The National Tidal Datum Convention of 1980, have been required to modify the existing system in order to achieve this consistency. The actions are: (1) to compute the tidal datums of Mean High Water and Mean Low Water as the average of all the high and low waters, respectively; (2) to lower chart datum from Mean Low Water to Mean Lower Low Water along the Atlantic Coast; (3) to change the name "Gulf Coast Low Water Datum" to "Mean Lower Low Water"; and (4) to update the National Tidal Datum Epoch from the 1941 through 1959 series, to the 1960 through 1978 series. The Convention provides a tidal datum system independent of computations based on type of tide. Thus, a great regional importance, a uniform and continuous tidal datum of Mean High Water (without vertical jumps due to change in computational method with type of tide) and a Mean High Water Line (without concomitant horizontal discontinuities) has been generated along the Gulf coast. Likewise, Mean Higher High Water has been created in areas of predominantly diurnal tides, thus providing a uniform and continuous Mean Higher High Water Line along the Gulf. Lowering chart datum from Mean Low Water to Mean Lower Low Water along the Atlantic coast and changing the name, "Gulf Coast Low Water Datum," to "Mean Lower Low Water," along the Gulf has placed chart datum at a common elevation for all tidal waters of the United States, U.S. Possessions and Territories, and U.N. Trust Territories under U.S. jurisdiction. Updating the National Tidal Datum Epoch adjusts all tidal datums for the effects of continuing long period sea level variations.

Holdahl, S.

A model of temperature stratification for correction of leveling retraction. Second International Symposium on Problems Related to the Redefinition of North American Vertical Geodetic Networks, Ottawa, Canada, May 1980.

Unless an observing procedure is especially designed to detect refraction, its presence will usually go unnoticed. Leveling refraction is an error which causes observed height differences to be too small; consequently, the determined heights of mountains will be too low. In North America the error is likely to amount to four decimeters or more. The magnitude of leveling refraction depends on the density of air layers through which the level instrument looks. Air density depends primarily on temperature. During the day, solar radiation heats the ground and a curved vertical temperature profile is established. Excellent instrumentation now exists to sample the temperature at different heights while leveling is underway; thus air density can be estimated and correction can be formulated. However, for past leveling measurements, the meteorological input to the refraction correction must be obtained by modeling. The new model for this purpose uses monthly averages of solar radiation and precipitation at many locations to derive a temperature profile appropriate for the season and the time and place of measurement. Reductions in the specified maximum allowable sightlength in recent years cause less refraction error to be present in newer surveys. However, when old and new surveys are compared mountains appear to go up and valleys go down. Assymetry of terrain around circuits will also cause accumulations of refraction error to show up in circuit misclosures. The remedy is to correct all leveling data, using the above-mentioned model, prior to use in crustal movement studies or network adjustments.

Holdahl, S.

Crustal movement and redefinition of heights. Second International Symposium on Problems Related to the Redefinition of North American Vertical Geodetic Networks, Ottawa, Canada, May 1980.

Network adjustments to obtain heights are made difficult by vertical crustal movements operating over the period of network development. If crustal movements did not occur, old leveling observations could be added to recent work to obtain the strongest determination of modern heights. Crustal movements of up to 10 meters have occurred in North America, due to a variety of natural and artificial causes. Therefore, the geodesist must use filtering, weighting, and modeling procedures in order to obtain meaningful heights corresponding to a single point in time. Rates of vertical crustal motion can at least be modeled and mapped in the course of executing the investigations leading to the redefined heights of the combined North American networks. It is not known at this time whether the density of relevelings and the uniformity of vertical movement will be sufficient to permit simultaneous determination of heights and rates of height change.

Kalvaitis, A.

Test methods for marine measurements. 1980 Institute of Environmental Sciences Meeting, Philadelphia, Pennsylvania, May 1980.

This paper describes a series of environmental test specifications tailored for marine instrumentation. It represents a review and analysis of over 100 military specifications and standards and various commercial standards and

regulations. Included is a listing of the specific laboratory tests developed for determining the detrimental effect of natural elements and induced stresses incurred during the life cycle of the instrumentation. Also described will be the marine instrument classification system, the methods and test method sequence and a typical test, including purpose, rationale, determination of levels and detailed procedures. The test methods have been designed to simulate actual conditions encountered during storage, transit, and operation of instrument measuring systems for the non-military marine environment. The test levels and procedures were developed to provide a high degree of assurance that the instrument will survive the field environment based on satisfactory laboratory performance. In most cases, the levels represent worst likely conditions, rather than rarely occurring extreme conditions which are frequently used by other test standards for testing critical equipment.

Kumar, M.

Leveling rods and their calibration--National Geodetic Survey. American Geophysical Union Meeting, San Francisco, California, December 1980.

Since the survey of the first "geodetic" level line in 1856-57 by the U.S. Coast and Geodetic Survey, the design features, manufacturing processes, and calibration procedures for leveling rods have changed significantly. In addition to a brief historical description, the paper subjectively evaluates the state of the art and its development through the years.

Kumar, M. and Soler, T.

1978 Southern California releveling and its implications with respect to the sea slope problem. Marine Geodesy Magazine, November 1980.

Since the apparent sea slope along the Pacific coast between San Diego, California, and Neah Bay, Washington, was originally reported by Bowie in 1929, numerous points of view, both favorable and otherwise, have been expressed in the literature concerning this possibility. A recent interpretation proposes a complete agreement between geodetic and steric leveling. Another study shows a time variation of sea slope over a decade suggesting a possible rise of San Pedro with respect to San Francisco (or San Francisco subsiding with respect to San Pedro) at an average rate of about 8 cm/yr. However, tidal records do not reveal large changes in the trend of mean sea level relative to land at the tide stations. Nevertheless, our results from the 1978 Southern California Releveling Program (SCRP), completed in a period of less than six months, indicate large unexplained misclosures difficult to attribute to tectonic movements. Analysis of two routes from SCRP data between Avila Beach and San Diego, California, shows completely different sea slopes at the same epoch, hence eliminating the possibility of a time dependent phenomena. Our investigation concludes that there are still unkown variables affecting geodetic leveling which must be understood, clarified, and accounted for before any definitive assertion can be made about the role of crustal motions in an analysis.

Land, R.

The relation between the upper limit of coastal wetlands and tidal datums along the Pacific Coast. EPA Technical Paper, February 1980.

The relationship between the upper limits of coastal wetlands and tidal datums, as well as inundation levels, was investigated for 17 marshes along the Pacific coast. Based on 8 marshes (10 samples per marsh) in Oregon and Washington a standard elevation for the upper limits of coastal marshes (in this region) was computed .46 meter (1.5 ft) above mean high water (MHW). Based on 5 marshes (10 samples per marsh) in south and central California a standard elevation for the upper limits of coastal marshes, in this region, was also computed. A method of computing the equivalent of a 19-year mean frequency and duration of inundation tables at subordinate tide stations is described. An average percent frequency and duration of inundation at the upper limits of Oregon and Washington marshes (11.6 percent frequency, 2.0 percent duration) is shown. No inundation level was computed for south and central California because the upper limits of these marshes exceeded any inundation level.

Milbert, D.

A simulation of random error propagation for the United States leveling network. Second International Symposium on Problems Related to the Redefinition of the North American Vertical Geodetic Network, Ottawa, Canada, May 1980.

The National Vertical Control Network for the continental United States is modeled by a rectangular grid of regular spacing. Basic Net A of the U.S. network is approximately 2,000 km to the north and south, 4,000 km to the east and west, and consists of about 300 loops. A leveling grid of 25 loops by 12 loops, with each loop 160 km square, specifically models the U.S. vertical network. The normal equations for this simulated network are formed using a level difference observation variance that is proportional to the section length (160 km). The inverse within the profile is computed to yield the variances of the adjusted heights and the variances of the adjusted observations. The behavior of the height and adjusted observation variances are investigated with respect to the manipulation of several factors. Elevations along the edges of the grid are constrained at different weights. The effects of elevation observations at the interior of the grid, such as from satellite observations, are examined. Also the first order, class III leveling network is modeled and added to the underlying grid. The ease in achieving results, particularly when compared to the anticipated effort in performing the North American vertical network adjustment demonstrates that simulation techniques hold promise for the analysis of weighting systems and error propagation.

Moore, T.

Management of NOAA Fleet electronics equipment. Radio Technical Commission for Marine Services, Washington, D.C., April 1980.

National Oceanic and Atmospheric Administration (NOAA) marine programs include Fishery Conservation and Management, Nautical Chart Services, and Ocean Investigations. The NOAA Fleet provides equipment platforms for conducting these programs and electronic support services help to insure that these programs are satisfactorily completed. This paper discusses shipboard electronics equipment, as used in some of these programs, including instrumentation and communications, navigation, radio location, acoustic and digital equipment. How this electronic support equipment is managed to obtain maximum use of existing equipment and the procedures for replacing this equipment are reviewed. Requirements for the 1980's are listed as well as the impact of the World Administrative Radio Conference on implementation of electronics equipment for the NOAA Fleet.

Morris, P.

National Ocean Survey Great Lakes water levels program. American Congress on Surveying and Mapping Fall Technical Meeting, Niagara Falls, New York, October 1980.

The history of collecting water level measurements in the Great Lakes Basin began when the Corps of Engineers organized the United States Lakes Survey in response to the Congressional Act of March 3, 1841. This Act authorized the Corps of Engineers to produce a hydrographic survey of the Great Lakes. It also led, in 1860, to the operation of 17 gages and the commencement of systematic measurements of lake levels. The Corps of Engineers continued to measure the lake levels until 1970 when the National Oceanic and Atmospheric Administration took over the Great Lakes Water Levels Program in compliance with the executive orders under Presidential Reorganization Plan No. 4, which placed the measurement of lake levels within the National Ocean Survey. From the beginning, the gage network and methods of reference and measurement have been under periodic change to improve and meet ever-increasing demands for more accurate, pervasive, and timely data. Today, the National Ocean Survey's Water Level Program is composed of the basic water level measurements, maintenance and evaluation of the International Great Lakes Datum (IGLD), summarization of basin precipitation, abstraction of flows and diversions, provision of hydrographic survey vertical control, and a concerted effort to plan for the imminent and future needs of the user community.

Morrison, F.

Computing the potential and attraction of a density layer by means of elliptic integrals. Manuscripta Geodaetica, Vol. 5, 1980.

The computation of the potential and attraction of blocks of constant surface density on a figure of rotation may be facilitated by the use of elliptic integrals. In particular, the integration with respect to longitude may be done in closed form using elliptic integrals of the first and second kinds. Then the integration with respect to latitude may be executed by numerical quadrature. An IBM System 360 FORTRAN IV program, suitable for blocks of any size is given.

Park, K.

Future prospects of ocean dumping. Ocean Dumping Symposium Volume, February 1980.

The preceding volumes of this book have considered specific technical aspects of several industrial wastes that are disposed in the ocean. In this concluding chapter we will summarize a number of general considerations related to ocean dumping. Our approach will be somewhat philosophical and idealistic in which we bring together common thoughts on waste disposal in the marine environment, on the technical assessment of ocean dumping practices, on the approaches to monitor waste disposal, and on recommendations for future work.

Parker, B.

The attenuation of tidal waves in a long narrow semi-enclosed basin. EOS: Transactions of the American Geophysical Union, April 1980.

Using cotidal and corange charts determined from extensive tidal data from the Strait of Juan de Fuca-Strait of Georgia, a one-dimensional analytical model is used to show the relative importance of four mechanisms of attenuation in this waterway. The M_2 tidal wave undergoes a 17-percent amplitude reduction in the area of the San Juan Islands and undergoes an imperfect reflection at the northern end of the Strait of Georgia, reducing the amplitude of the reflected wave by 18 percent. The continuous attenuation of the M_2 wave is represented by an exponential damping coefficient of 0.75 per M_2 wavelength (i.e., a 53 percent reduction in amplitude per M_2 wavelength); this includes the effect of both frictional losses and wave scattering. The K_1 tidal wave is similarly affected by the San Juan Islands and the imperfect reflection at the northern end of the Strait of Georgia. However, the exponential damping coefficient is only 0.1 per K_1 wavelength (i.e., a 10-percent reduction in amplitude per K_1 wavelength). The greater attenuation of the M_2 wave is mainly a result of the greater effect of wave scattering on the M_2 wave than on the K_1 wave, and the greater frictional loss because of larger M_2 than K_1 current amplitudes.

Parker, B. and Bruce, J.

Puget Sound approaches circulatory survey. NOS Oceanographic Circulatory Survey Report No. 3, August 1980.

During the period from the fall of 1973 through the fall of 1976, a seven-phase circulatory survey was carried out by the National Ocean Survey (NOS) in the waters of the Strait of Juan de Fuca, Haro and Rosario Straits, and the Strait of Georgia, referred to collectively as Puget Sound Approaches. Extensive and detailed measurements were made of currents, tides, and the temperature and salinity of the water, along with additional measurements of various atmospheric parameters, such as wind speed and direction, sea-level pressure, and air temperature. This report provides details about this survey including locations of stations, time periods of occupation, instrumentation, sampling rates, and data processing techniques; numerous charts and tables are provided. Also included is a chapter summarizing all current and tide data taken by NOS in this area prior to the present survey.

Patchen, R. and Gottholm, B.

The response of the shelf to Hurricane Belle, August 1976. Journal of Physical Oceanography, January 1980.

On 10 August, 1976, when Hurricane Belle passed through the New York Bight, the region was instrumented from various sources. The data set included meteorological information from the National Weather Service, water level information from the National Ocean Survey, and current meter and STD information from the Marine Ecosystem Analysis Program. Hurricane Belle can be classified as a fast moving storm translating over a two-layer density structure. The temporal and spatial responses to the hurricane were determined using spectral and residual techniques.

Pendleton, D.

Aeronautical Chart Automation: Concept and Status. The Ninth United Nations Regional Cartographic Conference for Asia and the Pacific, Wellington, New Zealand, February 1980.

The aeronautical charts produced by the National Ocean Survey (NOS), serve the needs of civil aviation of the United States including many independent users in civilian, business, and commercial aviation. In recent years, increased use of the U.S. National Airspace System, and more complex air traffic control regulations and procedures have heavily impacted the task of producing and maintaining aeronautical charts vital to air safety. To meet this challenge, the NOS is turning to the use of advanced computer technology to increase productivity of existing personnel by developing a computer-assisted aeronautical chart production system to handle the increasing workload requirement. The objective of the project is to design, develop, and implement a computer-assisted system in which the judgment and decision making abilities of the professional cartographer are incorporated into the production of the final cartographic products.

Phillips, J.

Specifications to support classification, standards of accuracy, and general specifications of geodetic control networks. Federal Geodetic Control Committee, NOAA publication, March 1980.

Rapid evolution of economic and technological factors since 1957 made evident the need for greater flexibility in the design and performance of surveys. As a result, the Federal Geodetic Control Committee formulated Classification, Standards of Accuracy, and Geodetic Specifications of Geodetic Control Surveys (FGCC 1974), which provides detailed specifications and general procedural guidance for surveys included in the National Geodetic Control Networks. Geodesy (i.e., control surveys) is the common denominator that relates and coordinates the Nation's and the world's activities in a physical three-dimensional mode. The more commonly used geodetic data include latitudes, longitudes, elevations, deflections of the plumb line, and gravity values. One of the multitude of uses for these data is the construction of maps and

charts which, in turn, relate the horizontal and vertical positions between all cartographic features on a given map with those features on any other map of the Earth. Thus, the accuracy of cartographic presentations is directly related to the accuracy of the National Geodetic Control Networks.

Poetzschke, H.

Motorized leveling at the National Geodetic Survey. International Symposium on Motorized Leveling, Wiesbaden, West Germany, September 1980.

Since the early 1900's various forms of motorized leveling modes have been attempted to speed up leveling operations. Faster progress in leveling is a desirable goal because observations have to be taken in the most critical part of the atmosphere--near the surface of the ground. A short review of the existing systems of motorized leveling is given, and the operational system of the National Geodetic Survey is described. The results show the improvements achieved with the NGS system.

Pope, A.

Applications of modern statistics in leveling. Second International Symposium on Problems Related to the Redefinition of North American Vertical Geodetic Networks, Ottawa, Canada, May 1980.

Within a general framework for statistical methodology in geodetic adjustment theory, a new method for carrying out an analysis of variance with random effects in the general case is described.

Robertson, D.

Geodesy by radio interferometry: intercontinental distance determinations with subdecimeter precision. Journal of Geophysical Research, June 1980.

Analysis of very-long-baseline interferometer (VLBI) observations yielded estimates of the distances between three radio telescopes in the United States and one in Sweden, with formal standard errors of a few centimeters:

Westford, Massachusetts-Onsala, Sweden	5,599,714.66±0.03m
Green Bank, W. Virginia-Onsala, Sweden	6,319,317.75 0.03
Owens Valley, California-Onsala, Sweden	7,914,131.19 0.04

where the earth-fixed reference points are defined in each case with respect to the axes of the telescopes.

Robertson, D.

Some consideration in use of Very Long Baseline Interferometry to establish reference coordinate systems for geodynamics. International Astronomical Union Colloquium No. 56, Warsaw, Poland, September 1980.

Present knowledge of the number, distribution, proper motion, and structures of extragalactic radio sources indicates that there should be no problem in defining a celestial reference frame with stabilities of a few milliseconds of arc over time spaces of the order of a decade. One of the limiting factors appears to be the structure of the sources. By measuring and monitoring these structures, the stability could probably be improved by as much as one or two orders of magnitude. Even without this improvement, a network of properly distributed fixed observatories making regular interferometric observations of these radio sources could be used to define a terrestrial coordinate system that could be maintained at the few centimeter level over indefinitely long time periods. Such a stable terrestial reference system would be useful for a host of modern geodetic and geodynamic applications including, in particular, studies of the time varying deformations and relative motions of lithospheric plates. The National Geodetic Survey has already begun work on a three-station base network of permanent observatories under project POLARIS as a first step toward implementing the new celestial and terrestrial reference frames. It is hoped that others will join in the effort and make the new reference frames a reality by the middle of this decade.

Rulon, T.

Determining the geographic coordinates of laser measured depths. Laser Hydrography Symposium, Adelaide, Australia, October 1980.

The National Ocean Survey's (NOS) goal is to determine the horizontal position of each leaser-measured depth to an accuracy of 4.56m (1 sigma) relative to shore control. The system uses an aircraft-mounted, pulsed laser beam that is scanned at 20° off-nadir to collect a swath of discrete soundings along each flight line. The NOS system will take 600 soundings per second over a 222m wide swath yielding an average distribution of 1 per $25m^2$. The system will operate from a light twin-engine aircraft flying at an altitude of 1000 feet and a velocity of 150 kt. This paper will examine several technologies suitable for accurately measuring the positioning parameters. An error analysis conducted to determine the horizontal error as a function of the six required parameters (X, Y, Z, ρ, θ, ϕ) is used to establish the requirement for an on-board inertial system to determine the heading of the aircraft. Examining the state-of-the-art for both gimbled and strapdown inertial systems, the Roll/Pitch and heading accuracy has been determined to be on the order of .2° (1 sigma). Combined with errors attributable to the laser system, a proposed error budget has been developed as a means of determining the horizontal accuracy required for the aircraft.

Slama, C.

On the inclusion of photogrammetry in the "Classification, Standards of Accuracy, and General Specification of Geodetic Control Surveys." American Congress on Surveying and Mapping Spring Conventions, St. Louis, Missouri, March 1980.

In February 1974 the Office of Management and Budget published "Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys." The purpose of that document was to describe and explain the standards of accuracy associated with the National Network of Geodetic Control and to provide guidance in the methodology of surveying to meet the prescribed standards. Recently, new procedures for establishing ground positions have been developed which are more economical and provide data that can be considered of "geodetic" quality. One such method employs aerial photography and "photogrammetric" techniques commonly referred to as "analytical aerotriangulation." Other new methods employ satellites and doppler techniques to determine spatial coordinates. Because of these new techniques, it was suggested that a revised version of the specifications and standards be prepared which would include references to this new technology. The purpose of this paper, then, is to discuss a proposed table of standards and specifications which are considered to reflect the "state-of-the-art" for positioning through the use of analytical photogrammetric techniques. It is beyond the scope of this paper to discuss the results of the experimental data used as a basis for these specifications, and therefore the discussion will concentrate mainly on the reasoning behind the inclusion of certain categories of specification and the basis for certain specified geometries.

Slama, C.

Special Applications of Analytical Stereoplotters, ASP, Analytical Plotter Symposium Workshop, Reston, Virginia, April 1980.

In mid-1976 specifications were written and a contract was awarded to Ottico Meccanica Italiana Corporation of America (O.M.I.C.A.) for the fabrication of a unique analytical plotter now known as the National Ocean Survey Analytical Plotter (NOSAP). A complete description is given by Fritz (1979). This paper will present a general overview of some of its many capabilities, a description of some nonstandard applications, and finally, a look to future extended applications.

Slama, C.

Test Results of a High Precision Analytical Photogrammetric System. The Ninth United Nations Regional Cartographic Conference for Asia and the Pacific, Wellington, New Zealand, February 1980.

Spurred by advances in computer technology and measuring techniques, the NOAA's National Ocean Survey (NOS) began an investigation in 1975 of high precision analytical triangulation for possible applications to the densification of geodetic ground control. The system investigated employed a special camera lens cone with an incorporated projected reseau. All ground points are targeted

before photography, the mensuration is partially automated, and optimum geometry of the photogrammetric solution is obtained by special flight-line configurations. The systematic errors normally encountered in photogrammetry are minimized by image optimization, calibration of the camera's lens inner geometry using stellar methods, thorough calibration of the camera reseau, multiple pointing during mensuration, complete calibration of the mensuration device, and rigorous treatment of the observations in the adjustment computation. Test data flown over the Casa Grande target range provided eight difference photo coverage configurations to study the relationship between geometry and final adjusted data for the optimum case show an RMS difference between geodesy and photogrammetry of .046 meter for 225 points. This represents a ratio of photo scale to error (in meters) of 516, 158 or a five time's improvement over that reported by NOS in previous experiments.

Smith, R.

Golden Gate Tidal Measurements: 1854-1978. Journal of the Waterway, Port, Coastal, and Ocean Division, Vol. 106, No. WW3, August 1980.

The recent discovery of leveling connections between the bench marks of the tide stations at Fort Point, Sausalito, and The Presidio, San Francisco, California, between 1954 and the present, provide a continuous set of tidal measurements in the Golden Gate area. This is the only location in the United States with over 100 years of continuous tidal measurements. Such a long series of tidal measurements are important in global sea level analysis, variability of water level relative to land over long periods and historical tidal boundary determination.

Smith, R.

Tidal History of the San Francisco Bay Estuarine System--1854- 1979. American Geophysical Union 1980 Fall Meeting, San Francisco, California, December 1980.

In 1850 the San Francisco Bay estuarine system was still in its "natural" state, but the transfer of the ownership of salt marshes and tidelands from the State of California to private developers lead to subsequent land speculation and large-scale reclamation through diking and landfills in the tidal margins. Throughout this period of changes in the Bay Area estuarine system--sloughs, marshes, channels, and rivers--the National Ocean Survey has made continuous, uninterrupted tidal observations at the Golden Gate (1854-1979), and intermittent observations at numerous other locations throughout the system. All tidal heights, ranges, diurnal inequalities, and time intervals for these locations have been reduced to mean values by comparing them with simultaneous observations at the Golden Gate. There is a measurable difference in the tidal characteristics from the entrance to San Francisco Bay to the south and north Bay, San Pablo Bay and its tributaries, Carquinez Strait, Suison Bay, and the San Joaquin and Sacramento River regions. There is not only measurable difference in tidal characteristics between these localities at any one time, but also continuing changes with time, the most pronounced of which occur in the Carquinez Strait region.

Smith, R. and Leffler, R.

Water level variations along the California Coast. Journal of the Waterway, Port, Coastal, and Ocean Division, Vol. 106, No. WW3, August 1980.

Daily, monthly, yearly, and long-term variations in sea level relative to land, and highest water levels are examined at 15 locations along the California coast. The longest, uninterrupted, set of tidal measurements (1954-1978) in the United States are at the Golden Gate. Such a series is invaluable in long-term sea level variation studies and storm frequency analysis. Maximum expected heights with time for the Golden Gate are computed and graphed. Graphs displaying the highest water level each month for the period 1933 through 1977 for four widely distrbuted long-term stations in California indicate the frequency of occurrence and maximum vertical heights.

Snay, R.

Crustal movement investigations at Tejon Ranch, California. NOAA Technical Report NOS87 NGS18 (PB 81-119000) June 1980.

From 1964 to 1978, the National Geodetic Survey has observed during ten epochs two small and recently interconnected networks, RANCH and TEJON, which span two branches of the Garlock fault in California's Tehachapi Mountains. The ten epochs of data, simultaneously adjusted using the least-squares methods and with the faults mathematically modeled, show that the horizontal crustal motion has varied nonlinearly with respect to time. The southern branch of the Garlock fault, spanned by the RANCH network, exhibited left-lateral strike slip and dip slip corresponding to normal faulting. Subsidence measured by vertical observations at this branch indicates that the fault dips southerly.

Snay, R.

Extracting horizontal crustal deformation from historical geodetic data. American Geophysical Union 1980 Fall Meeting, San Francisco, California, December 1980.

In support of the project to redefine the North American Horizontal Datum, the National Geodetic Survey has undertaken the task of modeling historial horizontal crustal deformation for various regions of the United States. During the adjustment of the North American observations, these models will account for the time variability of station coordinates. Secular motion within a region will be modeled as a mosaic of blocks which are allowed to translate and deform as a linear function of time. Moreover, deformation within each block will be a linear function of position. Episodic displacements resulting from major earthquakes will be modeled in accordance with the theory of dislocation in an elastic halfspace. The first area to be modeled is the region of California south of 33.5° latitude.

Spencer, J.

Geodetic information, its avàilability and explanation. American Congress on Surveying and Mapping 1980 Fall Technical Meeting, Niagara Falls, New York, October 1980.

National Geodetic Survey products and services will be discussed and a general information packet will be given to each attendee. The products include the new formats of horizontal and vertical control data and control diagrams. Similar formats will be used when the North American Datum of 1983 (NAD83) and National Geodetic Vertical Datum of 1987 (NGVD87) results are published. Available services include the processing and distribution of geodetic data and diagrams to subscribers of the automatic mailing service as well as responses to individual requests.

Spencer, J. and Collom, J.

Geodetic network diagrams. American Congress on Surveying and Mapping Bulletin, No. 71, November 1980.

The first national geodetic control diagram was a project sketch of the geodetic field survey performed in the vicinity of New York City in 1816-17. From this early beginning until the 1840's, horizontal control (triangulation) networks were shown on nautical charts. After that period, until the last general adjustments in 1927 and 1929, geodetic control diagrams were shown as project sketches in the final survey reports. With the completion of the North American Datum of 1927 (NAD27) and the National Geodetic Vertical Datum of 1929, (NGVD29) tremendous network densification surveys were begun by various governmental and private organizations. The first mass production of geodetic network diagrams occurred in the mid-1930's. They were used then, as today, to assist the user in making specific station selections and to develop plans for future surveys. When the new adjustment of the North American Datum of 1983 (NAD83) is completed, we can again anticipate tremendous network densification survey activitiy. Geodetic control diagrams depicting these network results as well as supplementary survey connections will be available to the user by means of computer-assisted cartography. The National Ocean Survey (NOS) is presently procuring an automated cartographic system to accommodate present and future needs for geodetic control diagrams.

Spillman, D.

National Ocean Survey collection of tidal data in the coastal zone--equipment problems and improvement efforts. Twenty-sixth Annual Technical Meeting of the Institute of Environmental Sciences, Philadelphia, Pennsylvania, May 1980.

The National Ocean Survey (NOS) has been collecting and analyzing tidal data since the early 1800's. This paper describes the NOS tidal data collection program and equipment problems with the present data collection systems. An equipment improvement program required by the recent large increase in demand for tidal data is discussed.

Stanley, W.

The nation's chartmaker. NOAA Magazine, October 1980.

The first two decades of the nineteenth century saw the formation of a scientific organization that became the cornerstone for hydrographic and geodetic technology. Modern science began in the seventeenth and early eighteenth centuries. The dynastic states of Europe had little difficulty in establishing scientific traditions. American maritime scientific tradition began with the economic needs of the new republic. A principal point of concern in the early stages of the Federal Government was commerce, and the new nation's obvious need to assure Europe that America wanted its goods and needed its partnership. A vital sector of this commercial link was ocean shipping. Discussion begins with President Thomas Jefferson's interest in assuring Europe the new republic would safeguard foreign commerce entering American waters. The development of the first three hydrographic organizations - "Survey of the Coast," the Depot of Charts and Instruments, and the Nautical Almanac Office are described in detail, each playing a major role in the evolution of hydrographic cartography. The advances made by each organization complimenting the identity of the new republic in the world scientific community are discussed and evaluated. The U.S. Coast and Geodetic Survey from the 1880's to the mid-1940's was ingratiated with international acclaim as a leader in the physical sciences particularly in the fields of geodesy and hydrography. Specific examples are given of advances made by the Survey. As the organization moved into the present time discussion is made of its structure and political motivations during the 1960's. Present-day scientific achievement and organization bring the conclusion that that the Survey of tomorrow will explore the far reaches of scientific interest in areas of geodynamics, remote sensing surveys, ultra-precise numerical photogrammetry, and coastal mapping.

Strange, W.

The effect of systematic errors on geodynamic analysis. Second International Symposium on Problems Related to the Redefinition of North American Vertical Geodetic Networks, Ottawa, Canada, Mary 1980.

One of the greatest problems in geodynamic analysis of leveling is the potential existence of systematic error. Height correlated systematic errors--errors in rod calibration and errors in application of refraction correction--are especially troublesome because they may not be identifiable in loop closure analysis. Of these two, refraction correction error is more complex in its effects because it is a function of temperature gradient and the square of sight length, in addition to height difference. On occasion, large systematic differences occur between the backward and forward levelings on line of double-run leveling. Unless the occurrence of such an error can be precluded, the use of single-run leveling for geodynamic analysis is extremely dangerous. Based on analysis of repeat levelings in California, examples are given of the effects of various types of systematic errors on geodynamics. The possible magnitude and probability of occurrence of the various types of error are illustrated. It is concluded that by careful attention to systematic errors valuable geodynamic information may be gained from repeat levelings. However, failure to identify systematic errors can lead to totally incorrect conclusions.

Strange, W.

The impact of refraction correction on leveling interpretations in California. EOS: Transactions of the American Geophysical Union, May 1980, and Journal of Geophysical Research, November 1980.

Recent investigations show that the refraction correction in leveling is large but can be adequately modeled. The correction is proportional to the temperature gradient and to the square of the sight length. Differences in sight length are often more important than differences in temperature gradient in causing differences in the magnitude of the correction between surveys.

Swisher, W.

National Ocean Survey Automated Information System. Ninth United Nations Regional Cartographic Conference for Asia and the Pacific, Wellington, New Zealand, February 1980.

The National Ocean Survey is automating the processes required to create and maintain nautical charts. Automated techniques have been introduced in three basic areas: data management, interactive graphics, and management reporting. The National Ocean Survey Automated Information System (NOS/AIS) uses some of the latest advancements in data processing to perform these functions. An on-line geographically-oriented data base coupled with an array of interactive graphics systems enables cartographers to maintain up-to-date charts.

Vanicek, P.

Tidal corrections to geodetic quantities. NOAA Technical Report, NOS83 NGS14, February 1980. (PB80-189376)

All aspects of tidal correction are discussed from a geodetic point of view, although no original material is presented. The origin of tidal force is explained and mathematically treated. Then, the phenomena which cause tidal force are viewed, first as being rigid and then elastic. Corrections are formulated, based on these tidal phenomena, including the complete range of geodetic observations.

Vanicek, P. and Grafarend, E.

On the weight estimation in leveling. NOAA Technical Report, NOS86 NGS17, July 1980. (PB81-108284)

This report addresses the problem of linear propagation of statistically dependent errors. It is shown that the laws of propagation of statistically independent and totally statistically dependent (systematic) errors are in the lower and upper bounds of all the possible linear laws. The particular form of propagation laws covering the region between the bounds depends on the covariance function governing the statistical dependence: different covariance functions give rise to different families of law. Working with continuous

models of discrete cases and with one parametric nonnegative function, it is possible to arrive at some general conclusions. The concepts are demonstrated for the case of leveling. Two examples of possible covariance models and the corresponding propagation law are given.

Vincenty, T.

Height controlled three-dimensional adjustment of networks. American Congress on Surveying and Mapping Bulletin, October 1980.

Adjustments of horizontal observations (distances, directions, azimuths) are traditionally performed on the surface of a arbitrary ellipsoid of revolution. To reduce the observations to the ellipsoid we must know (1) the heights of points with respect to the ellipsoid (not to be confused with heights above sea level) and (2) the direction of gravity at all stations at which theodolite observations took place (Schwarz, 1979). Ellipsoidal heights are obtained by applying geoidal separation corrections to heights above sea level. The direction of gravity is expressed by astronomic latitude and longitude. Since astronomic observations are not made at all stations, an interpolation procedure, often assisted by gravimetric measurements, is needed. If no astronomic values (observed or derived) are furnished, the implied assumption is that they are the same as the corresponding geodetic values, which falsifies the final results to some extent, depending on circumstances.

Vincenty, T.

Recent additions to the HOACOS height-controlled network adjustment program. NOAA Technical Memorandum, NOS NGS25, 1980. (PB80-223324)

The HOACOS height-controlled adjustment program has been revised to make the program more general in application. Its new features include the adjustment in the geodetic horizon system, a change of units for compatibility with other programs, a revised method of treating the direction of gravity at stations with no astronomic data, and a means of handling of observations when some heights are not given.

Ward, G.

Evaluation of sodium ion-selective electrodes in freshwater and seawater. EPA Technical Report, January 1980.

Five sodium ion electrodes, each manufactured by a different company, were evaluated in freshwater and seawater media. Each sensor was tested for the following parameters: accuracy, precision, temperature dependence, short- and long-term stability, durability, response time as a function of temperature and sodium concentration, variations between manufacturers, sensitivity to variations in light intensity and flow conditions, and suitability for application as components in monitoring or in situ chemical analysis sytems. Three different types of sodium electrodes were evaluted at 10°C and 25°C in freshwater, synthetic seawater (35-, 20-, and 5-ppt salinity), Atlantic Ocean water, (5- and 20-ppt salinity), and Chesapeake Bay water (5-ppt salinity).

Westbrook, D.

Proceedings of the National Ocean Survey Hydrographic Survey Conference, Seventh Annual Meeting, Gaithersburg, Maryland, January 1980.

This Seventh Annual National Ocean Survey (NOS) Hydrographic Survey Conference was distinguished by the participation of the U.S. Navy Oceanographic Office, the Defense Mapping Agency, and the Canadian Hydrographic Service. Communication of ideas and discussion of problems have been objectives of this conference from its inception. The interchange of information with representatives of these other surveying and mapping agencies contributed greatly to meeting these objectives, and, we hope, will warrant the continuation of their association with the conference in the future. Information contained in these proceedings is in the public domain. The views presented do not necessarily reflect the policy of NOS.

Whalen, C.

Readjustment of the National Geodetic Vertical Datum. EOS: Transactions of the American Geophysical Union, April 1980.

New geodetic techniques and computer technology are providing Federal scientists in the United States and other countries of North America with the precise tools needed to modernize the North American geodetic control networks--a web of horizontal and vertical survey-lines that span the continent. When the project is completed in 1987, its unprecedented accuracy will provide a base for mapping and engineering projects, an inventory of natural resources, land parcel recordation, and the launch and recovery of space vehicles. In particular, the earth scientist will have available, in an instant, 100 years of historical geodetic data in computer-readable form, supplying valuable data on crustal motion and earthquake prediction.

Whalen, C.

Refraction errors in leveling--NGS test results. Second International Symposium on Problems Related to the Redefinition of North American Vertical Geodetic Networks, Ottawa, Canada, May 1980.

The National Geodetic Survey (NGS), a component of the National Ocean Survey, NOAA, conducted leveling refraction tests at a site near Gaithersburg, Maryland, during July-September 1979 and March 1980, and at a site near Tucson, Arizona, in April 1980. The tests were designed to measure refraction errors by comparing refraction-free elevation differences with nominal 2 m observed elevation differences between bench marks at sight distances of 30, 45, 50, and 60 m. The refraction-free elevation differences were determined using sight distances generally less than 13 m. Preliminary results of the 60 m sight distance observations are reported. A full report will be published at a later date. The effectiveness of refraction correction equations by Kukkamaki and by Garfinkel were evaluated using temperature differences computed from temperatures observed at 0.5, 1.5, and 2.5 m above the surfaces of the test sites. Modeled temperatures by Holdahl and Whalen, mean temperature differences, and

Best's temperatures observed in Southern England in 1931-1933, were also evaluated. Refraction errors summed to -6.5 cm at an accumulated sight distance of 26 km at the Gaithersburg test site, and to -15.9 cm at an accumulated sight distance of 29 km at the Tucson test site. Both refraction equations removed more than 80 percent of the refraction error when used with temperatures observed at the two test sites. For the Gaithersburg test, the equations overcorrected by up to 6 percent when used with Holdahl's and Whalen's modeled temperatures. For the Tucson test, Holdahl's modeled temperatures, when used with Kukkamaki's equation, overcorrected by 34 percent and Whalen's modeled temperatures undercorrected by 35 and 46 percent respectively, when used with the Kukkamaki and Garfinkel equations. Best's Table temperatures, used with Kukkamaki's equation, undercorrected by 55 percent when used with the Gaithersburg test data, and by 65 percent when used with the Tucson test data. Use of a mean temperature of -0.8 degree Celsius for the Tucson test data, with the Kukkamaki equation, gave good results--lending some credence to Remmer's adjustment proceudre if it is used for a local survey.

White, H., Park, K., and O'Connor, T.

Biological effects of the marine dumping of industrial wastes at U.S. deep ocean dumpsites. International Council for Exploration of the Seas, Copenhagen, Denmark, October 1980.

The National Oceanic and Atmospheric Administration's Ocean Dumping Program has studied the biological effects of industrial waste dumping at two deepwater dumpsites, one off New York (106-Mile Ocean Waste Disposal Site) and the other off Puerto Rico. This paper reviews these studies. Field collections revealed the widespread occurrence throughout the Puerto Rico dumpsite of an active bacterial flora--perhaps introduced with pharmaceutical wastes--that grew well on agar without salt addition.

Yeager, A.

East Coast Shoreline Erosion Project. Second Symposium on Coastal and Ocean Management, Hollywood, Florida, November 1980.

Since the early 1800's the National Ocean Survey (NOS) has systematically mapped the shoreline and adjacent uplands of the United States. The primary purpose has been to provide a Mean High Water Line for nautical charts. This function is a basic mission of NOS and these historic surveys provide a fundamental data base for a wide variety of users in the solution of coastal zone management problems. A cooperative project with the Corps of Engineers, Coastal Engineering Research Center (CERC) has resulted in the prepartion of shoreline change maps for the barrier island system between Cape Hatteras, N.C., and Cape Henlopen, Del. All historic shoreline maps have been digitized and compiled by NOS in a composite form at a common scale (1:24,000) and horizontal datum. Coastal Engineering Research Center has performed an analysis based on area changes over time. A joint NOS/CERC report will be issued in 1981.